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Witch Flounder Catch Results from Fall 2000 GEAC Survey in NAFO Subdivision 3Ps

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Abstract

To enhance the fisheries research database in NAFO Subdivision 3Ps, the Groundfish Enterprise Allocation Council (GEAC) has funded surveys each fall from 1997 to 2000 directed at cod and flatfish. The focus in this document is witch flounder. The continuing intent is to create a series of annual fall surveys in 3Ps to complement current resource assessment activities carried out by the Department of Fisheries and Oceans (DFO). GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analysed on behalf of GEAC and for the additional intent of providing this information to DFO, for their databases and their assessment work. This is the third GEAC survey to investigate in detail the witch flounder catch following on the previous 1998-1999 surveys (CSAS Research Documents 99/59 and 2000/026). One trip to perform the 2000 survey was carried out from 4-15 December 2000. These dates correspond well with the late-November and December time periods for the earlier two years. During the trip, set details and length frequencies were logged in the DFO FFS system and otoliths were collected for subsequent aging. Catch statistics, length and age distribution, and stratified analysis estimates of witch abundance and biomass, including age distribution estimates, and interpretation of results are presented. The results of the 2000 survey appear to be generally consistent with those of 1998, in terms of abundance, and with both 1998 and 1999 in terms of the age and length population structure and overall distribution of the stock in 3Ps. While there were dramatic increases evident for a range of year classes in 1999 compared with the 1998 survey, and the abundance and biomass estimates were all up considerably, estimates for the 2000 survey indicate a population more comparable with that in 1998 with perhaps a very slight increase. This would even more strongly suggest that the increased numbers seen in 1999 appear to have been a year effect with temperature, catchability, or population movement factors at play.

Résumé

Pour améliorer la base de données de recherche sur les pêches pour la sous-division 3Ps de l'OPANO, le Conseil des allocations aux entreprises d'exploitation du poisson de fond (GEAC) a financé des relevés de la morue et des poissons plats effectués chaque automne de 1997 à 2000. Le présent document porte sur la plie grise. Ces travaux ont pour but d'obtenir une série de relevés annuels d'automne dans la sous-division 3Ps pour compléter les activités actuelles d'évaluation des ressources que mène le ministère des Pêches et des Océans (MPO). Le GEAC a financé et réalisé les relevés avec l'aide du MPO, qui a fourni des conseils scientifiques pour la conception et la réalisation d'un relevé aléatoire stratifié et des échantillonnages connexes. Les données ainsi recueillies ont été analysées pour le compte du GEAC et en vue de transmettre les résultats au MPO pour qu'il les entre dans ses bases de données et s'en serve dans ses travaux

d'évaluation. Ce document aborde le troisième relevé du GEAC qui examine en détail les prises de plie grise, pour donner suite aux résultats des relevés de 1998 et de 1999 (documents de recherche 99/59 et 2000/026 du SCES). Pour réaliser le relevé de 2000, une sortie a été effectuée du 4 au 15 décembre 2000, ce qui correspond aux périodes de sortie des deux années précédentes, soit la fin de novembre et décembre. Au cours de la sortie de 2000, les détails sur le mouillage des engins et les fréquences de longueurs ont été enregistrés dans le système FFS du MPO, et des otolithes ont été prélevés pour déterminer l'âge des poissons. Le document présente des statistiques de captures, la distribution des longueurs et des âges, des estimations par analyse stratifiée de l'abondance et de la biomasse, notamment des estimations de la répartition par âge, ainsi que l'interprétation des résultats. Les résultats du relevé de 2000 concordent généralement avec ceux de 1998 en ce qui concerne l'abondance et avec ceux de 1998 et de 1999 pour ce qui est des structures d'âge et de longueur de la population et de la répartition générale du stock dans 3Ps. Bien que plusieurs classes d'âge aient fortement augmenté en 1999 par rapport à 1998 et que les estimations de l'abondance et de la biomasse aient toutes présenté des hausses marquées, les estimations du relevé 2000 indiquent que la population s'approchait davantage de celle de 1998, la dépassant peut-être très légèrement. Cela porte davantage à croire que les effectifs élevés de 1999 seraient attribuables à l'effet d'une année exceptionnelle sur le plan de la température, de la capturabilité ou des mouvements de population.

Introduction

To enhance the fisheries research database in NAFO Subdivision 3Ps, the Groundfish Enterprise Allocation Council (GEAC) has funded surveys each fall from 1997 to 2000 directed at cod and flatfish. The continuing intent is to create a series of annual fall surveys in 3Ps to complement current resource assessment activities carried out by the Department of Fisheries and Oceans (DFO). GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analysed on behalf of GEAC and for the additional intent of providing this information to DFO, for their databases and their assessment work. This is the fourth such GEAC survey in 3Ps following on the 1997 to 1999 surveys and the third survey in which the witch flounder (grey sole) have been investigated in detail (following on CSAS Research Document 99/59 [1] and 2000/026 [2]). Interest in this survey was directed at cod, American plaice, and witch. One trip to perform the 2000 survey was carried out from 4-15 December 2000. These dates correspond well with the late-November and December time periods for the earlier two years. During the trip, set details and length frequencies were logged in the DFO FFS system and otoliths were collected for subsequent aging.

Under contract to GEAC, AMEC has taken the data logged using the DFO FFS system, combined with the aged otiliths, created digital data files appropriate for inclusion in the DFO (VAX computer system) databases, and performed a first analysis of the survey results. This document presents these results.

Methods and Materials

A Stratified Random survey was carried out in 3Ps by the *M.V. Pennysmart*. A summary of the trip is presented below.

Trip 5: Stratified Random Survey
Trip 5 was carried out from 4 to 15 December 2000. This time period is consistent with the 1997-1999 stratified random survey sets. The *Pennysmart*, the same boat as in the previous surveys and with the same captain, sailed from Marystown for operation in 3Ps, St. Pierre Bank, Halibut Channel, and Green Bank. Figure 1 shows a map illustrating the location of the strata surveyed. The survey was directed at cod, American plaice, and witch flounder. Set details, length, sex, and otolith information were sampled. Approximately five days of survey time were lost due to poor weather and sea conditions. This had the impact of limiting the number of sets performed to 75, approximately 10 to 20 fewer than in the previous three years.

Tows of duration 30 minutes using an Engels 96 high lift trawl with a 135 mm diamond mesh cod end (not lined) were conducted. The trawl was fitted with rock

hopper foot gear and Bergen #7 trawl doors. The 30 minute tows were commenced once the net reached the bottom.

Performance of the trawl was checked onboard using SCANMAR sensors: bridge display of doorspread and net opening (headline height) was visually monitored and these measurements together with trawl depth were noted every five minutes on the written bridge log for each set. The doorspread, opening, and clearance measurements were logged to computer disk using Seatrawl software. The trawl gear and configuration were identical to those used in the 1997-1999 surveys.

A total of 73 successful stratified random tow sets were completed. Two sets (#s 12 and 33) were unsuccessful: the net belly was torn and subsequently mended.

Data were logged using FFS with the length and otolith sampling carried out on board. The resulting ages were input to create an age and growth digital file.

Results and Discussion

Shore-based Analysis

The set details and witch length frequencies were exported from FFS to create ASCII data files. The age and growth data were keyed in following completion of the otolith aging by Bob Ennis. The sole focus in the work presented here is for witch.

The witch were sampled in 1 cm length groupings and all ratio/percentages of catch measured were applied.

ACON plots of the spatial distribution of catch weights are presented in Figure 2 and include the corresponding catch results from the 1998 and 1999 surveys. 2000 shows a catch distribution more like 1998 than 1999 with the greatest catch at the southern entrance to the Halibut Channel, but with very small or no catches elsewhere. Whereas in 1999 there were four sets with catch weights over 100 kg, three in stratum 319 at the southern entrance to the Halibut Channel and one at the southern tip of St. Pierre Bank in stratum 316, there was a single catch over 100 kg in 2000, also in stratum 319, and a single catch over 50 kg in 1998, also in stratum 319.

Table 1 presents a summary of the witch set details and catch numbers and weights. A total of 640 witch with total weight 298 kg were caught. The mean witch catch for the 73 stratified random sets is 8.8 fish and a mean set catch weight of 4.1 kg. These are comparable with the 1998 values of 7.2 fish and 2.8 kg and dramatically less than the 1999 values of 30.0 fish and 12.2 kg. In 1998, from 86 successful sets, a total of 616 witch weighing 243 kg were caught and in 1999, from 90 successful sets, a total of 2703 witch weighing 1101 kg were caught.

In 2000, the largest set was 351 witch weighing 167 kg, compared with largest sets of 784 and 324 kg in 1999, and 104 weighing 52 kg.

A catch of witch was reported in 29 of the 73 successful sets. The largest catch of 351 witch and weight 167 kg was from set 42 at the mouth of the Halibut Channel in a depth of approximately 175 m. The mean witch weight for all sets (total weight/total numbers) was 0.47 kg compared with 0.41 kg in 1999 and 0.39 kg in 1998.

Gear Performance

The survey gear performance was monitored with SCANMAR units mounted on the net for doors, opening, and clearance measurement. For the reported sets, doorspread exhibited a range of values varying from just under 40 m to just over 90 m (Figure 3). The mean doorspread and clearance values for 2000 are comparable to those measured with a NETMIND system used in 1999, viz., the mean doorspread in 2000 was 72 m compared with 74 m in 1999, and the mean clearance in 2000 was 5.4 m compared with 4.0 m in 1999. While no wingspread sensor was present on the net for 2000, given that the vessel and gear are the same and there is nothing apparent in the 2000 SCANMAR measurements to suggest a drastic change in performance, the assumption to use a 60 feet wingspread value for the all stratified analysis to date is made. This is also appropriate for preserving the three year relative index of abundance.

Length and Age

Figure 4 presents the length composition of the 2000 survey and, for comparison, results from the 1998 and 1999 surveys are also shown. For 2000, the sampled fish range in size from 26 cm up to 57 cm. The distribution shows a peak about the mean at 40 cm. The overall shape and magnitude of the length distribution is virtually identical to those for the other two years.

Figures 5a and 5b present age composition of the 2000 sampled witch. Figure 5a presents length versus age distribution. The mean age of 209 sampled witch was 9.1 years (compared with 8.9 years in 1999 and 8.8 years in 1998). The youngest and oldest fish were 5 and 14 years.

Figure 5b presents a bar chart of the sampled percent occurrence of witch at age for 1998 to 2000. The number of sampled witch are not quite the same for the three years, 295 in 1998, 361 in 1999, and 209 in 2000, hence the comparison by relative percentage. The 2000 distribution is generally quite similar to that of 1998, that is ages 9 (about 27%), 8 and 10 (about 16-22% each) are most frequent, with slightly lesser representation from ages 7, 11, and 12. The 1999 distribution shows ages 7 through 11 are the most frequent, each accounting for 12 to 20% of the samples, age 8 being the most common at 20%. Other than about a 3-5% increase in age 6 and 11 fish from 1999 compared with the other two years, and the noted greater prevalence of age 9 fish by about 10% in 1998 and 2000 compared with 1999, the overall age distributions are generally similar.

Stratified Analysis

Stratified Random surveys analysis was carried out using the DFO stratified analysis STRAP software and applying the French Exclusion Zone around St. Pierre et Miquelon for area calculations. A wingspread of 60 feet was used. Table 2a presents the STRAP output of estimated abundance and biomass. The estimated total number of witch for 3Ps is 6.3 million. The mean number of witch per standard 1.5 nautical mile tow is 7.6 comparable to the mean of 8.8 fish in Table 1. The estimated total witch biomass is 2.95 ktonnes. The mean catch weight per tow is 3.6 kg comparable to the mean of 4.1 kg in Table 1.

Table 2b presents a summary comparison of abundance and biomass STRAP estimates for 1998 to 2000. Estimates for 2000 are essentially consistent with 1998, 6.33 million fish compared with 4.65 million in 1998, and a biomass estimate of 2.95 ktonnes compared with 1.8 ktonnes in 1998. This provides further indication that the large catch and estimates from 1999 were due to a year effect. In all three years, the largest catch estimates have come from stratum 319: 33% and 41% of the abundance and biomass totals in 1998; 81% and 82% respectively in 1999; and 67% and 71% respectively in 2000.

Table 3a presents the STRAP age composition of numbers per tow, with sexes combined. The total mean number per tow is 7.6 (consistent with the value in Table 2a). The greatest numbers expected are at ages 9 (2.76 fish per tow), 10 (1.95 fish), and 8 (1.32 fish). Lesser numbers of fish are expected at ages 7, 11, and 12.

Table 3b presents a year class summary comparison of abundance STRAP estimates for 1998 to 2000. Year classes 1990 through 1992 are most evident. Other than the 1989 and 1988 year classes which had reasonable representation in the 1999 survey, 1990 to 1992 are the year classes most prevalent from the 1999 survey as well. Except for decreases in the estimates for the older 1987 through 1989 year classes, the estimates for 2000 in all other year classes are all up from those in 1998.

Tables 4a and 4b present the witch abundance and biomass estimates by strata for 1998 to 2000, arranged by depth regime. The estimates are generally comparable in all three years for each of the depth groupings except for the 51-100 fathom range in which the 1999 numbers are four times to more than 10 times greater than the neighbouring years. While the 2000 estimates are about three times greater than 1998 for the 51-100 fathom range, in all other regimes the 1998 values are slightly greater.

Figures 6a and 6b present the STRAP-estimated mean number of fish per tow and the percent occurrence of mean catch numbers per tow for the three survey years. Figure 6a indicates that while estimated numbers are greater by a factor of four to five in 1999 compared to the other two years, the 1998 and 1999 numbers are

generally consistent, with slightly increased numbers estimated in 2000 for ages 9 and 10. Comparing the relative makeup of the estimated tow numbers in Figure 6b, 2000 has the greatest proportion of age 9 and 10 year old fish of the three years but in general the overall distributions for the three years are quite similar.

Figures 7a and 7b illustrate the mean number of fish per tow and percent occurrence of the year classes from the STRAP mean catch per tow estimates. Figure 7b does suggest that the proportion of year classes 1986 to 1989 have all decreased gradually but uniformly each year since the 1998 survey, while conversely the opposite is true for year classes 1991 to 1993, that is the proportion of these year classes has increased uniformly from 1998 to 1999 to 2000. The proportion of 1990 year class witch has been about the same since 1998.

Figure 8 presents the STRAP-estimated abundance at length values for all sexes combined for the three survey years. Consistent with the sampled length distribution of Figure 4, the estimated length distributions have the same shapes for 1998 to 2000, with the greater numbers seen for 1999. The ranges are generally 22 to 56 cm and with peaks at 40.5 cm in 1998 and 2000, and 38.5 cm in 1999.

In summary, the results of the 2000 survey appear to be generally consistent with those of 1998, in terms of abundance and with both 1998 and 1999 in terms of the age and length population structure and overall distribution of the stock in 3Ps. While there were dramatic increases evident for a range of year classes in 1999 compared with the 1998 survey, and the abundance and biomass estimates were all up considerably, estimates for the 2000 survey indicate a population more comparable with that in 1998 with perhaps a very slight increase. This would even more strongly suggest that the increased numbers seen in 1999 appear to have been a year effect with temperature, catchability, or population movement factors at play.

References

[1] McClintock, J., 1999. "American Plaice and Witch Flounder Catch Results from Surveys in NAFO Division 3Ps." CSAS Research Document 99/59."

[2] McClintock, J., 2000. "Witch Flounder Catch Results from Fall 1999 Survey in NAFO Division 3Ps." CSAS Research Document 2000/026."

Table 1 Summary of Witch Catches for Stratified Random Survey Sets, NAFO Division 3Ps, 4-15 Dec 2000.

M.V. Pennysmart Vessel	Trip	Set	Year	Month	Day	StrLin	Division	Unit Area	Set Location Lat (N)	Set Location Long (W)	Witch Catch # of Fish	Witch Catch Weight (kg)	Set Duration (min)	Tow Distance (n.mi.)	Witch Mean Weight (kg)
49	5	1	0	12	4	322	3P	M29	46.56	55.71	0	0	30	1.5	
49	5	2	0	12	4	322	3P	M29	46.52	55.59	1	0.5	30	1.5	0.5
49	5	3	0	12	5	322	3P	M30	46.47	55.64	0	0	30	1.5	
49	5	4	0	12	5	322	3P	M30	46.44	55.87	0	0	30	1.5	
49	5	5	0	12	5	322	3P	L30	46.40	56.07	0	0	30	1.5	
49	5	6	0	12	5	314	3P	L30	46.29	56.46	0	0	30	1.5	
49	5	7	0	12	5	314	3P	L30	46.12	56.42	0	0	30	1.5	
49	5	8	0	12	5	320	3P	L30	46.08	56.67	0	0	30	1.5	
49	5	9	0	12	5	314	3P	L30	46.12	56.70	0	0	30	1.5	
49	5	10	0	12	5	314	3P	L30	46.25	56.65	0	0	30	1.5	
49	5	11	0	12	5	314	3P	L29	46.62	56.93	0	0	30	1.6	
49	5	13	0	12	5	311	3P	K29	46.83	57.15	2	0.5	30	1.5	0.3
49	5	14	0	12	6	310	3P	K29	46.88	57.13	11	4	30	1.5	0.4
49	5	15	0	12	6	310	3P	K29	46.85	57.29	14	5.5	30	1.5	0.4
49	5	16	0	12	6	313	3P	K29	46.70	57.38	8	3.5	30	1.5	0.4
49	5	17	0	12	6	312	3P	K29	46.63	57.31	1	1.5	30	1.5	1.5
49	5	18	0	12	6	713	3P	J29	46.56	58.72	2	1.5	30	1.5	0.8
49	5	19	0	12	6	713	3P	K30	46.45	57.69	0	0	30	1.4	
49	5	20	0	12	6	713	3P	J30	46.33	58.04	4	1.5	30	1.4	0.4
49	5	21	0	12	6	713	3P	K30	46.26	57.70	2	1.5	30	1.5	0.8
49	5	22	0	12	6	311	3P	K30	46.44	57.35	0	0	30	1.5	
49	5	23	0	12	6	313	3P	K30	46.39	57.37	14	7	30	1.5	0.5
49	5	24	0	12	7	312	3P	K30	46.33	57.22	0	0	30	1.5	
49	5	25	0	12	7	705	3P	K30	46.25	57.34	7	3	30	1.4	0.4
49	5	26	0	12	7	705	3P	K30	46.21	57.38	15	5	30	1.4	0.3
49	5	27	0	12	7	713	3P	K30	46.09	57.47	1	0.5	30	1.5	0.5
49	5	28	0	12	7	712	3P	K31	45.85	57.54	1	0.5	30	1.5	0.5
49	5	29	0	12	7	712	3P	K31	45.74	57.46	6	2.5	30	1.5	0.4
49	5	30	0	12	7	712	3P	K31	45.73	57.11	5	2.5	30	1.5	0.5
49	5	31	0	12	7	706	3P	L31	45.87	56.96	24	9.5	30	1.5	0.4
49	5	32	0	12	7	316	3P	L31	45.72	56.72	110	44.5	30	1.5	0.4
49	5	34	0	12	7	320	3P	L31	45.86	56.55	0	0	30	1.5	
49	5	35	0	12	8	706	3P	L31	45.56	56.64	13	6	30	1.5	0.5
49	5	36	0	12	8	706	3P	L31	45.51	56.65	12	5	30	1.6	0.4
49	5	37	0	12	8	320	3P	L32	45.38	56.05	0	0	30	1.5	
49	5	38	0	12	8	320	3P	M31	45.51	55.93	0	0	30	1.5	
49	5	39	0	12	9	318	3P	N32	45.09	54.60	5	4	30	1.5	0.8
49	5	40	0	12	9	319	3P	N32	45.11	54.87	0	0	30	1.5	
49	5	41	0	12	9	319	3P	N32	45.15	55.00	1	1	30	1.6	1.0
49	5	42	0	12	9	319	3P	M32	45.25	55.19	351	167	30	1.6	0.5
49	5	43	0	12	9	319	3P	M32	45.32	55.37	0	0	30	1.4	
49	5	44	0	12	9	319	3P	M32	45.18	55.36	2	0.8	30	1.4	0.4
49	5	45	0	12	11	318	3P	M32	45.08	55.44	0	0	30	1.6	
49	5	46	0	12	11	707	3P	M33	44.99	55.31	4	4.5	30	1.4	1.1
49	5	47	0	12	11	708	3P	M33	44.95	55.51	1	0.6	30	1.5	0.6
49	5	48	0	12	11	708	3P	M33	44.89	55.62	5	2.5	30	1.6	0.5
49	5	49	0	12	11	707	3P	M33	44.89	55.68	17	11	30	1.5	0.6
49	5	50	0	12	11	317	3P	M32	45.01	55.99	0	0	30	1.5	
49	5	51	0	12	12	317	3P	L33	44.97	56.06	0	0	30	1.5	
49	5	52	0	12	12	316	3P	L33	44.98	56.14	1	1	30	1.5	1.0
49	5	53	0	12	12	315	3P	L32	45.12	56.05	0	0	30	1.5	
49	5	54	0	12	12	315	3P	M32	45.10	55.88	0	0	30	1.5	
49	5	55	0	12	12	315	3P	M32	45.19	55.77	0	0	30	1.5	
49	5	56	0	12	12	315	3P	M32	45.37	55.62	0	0	30	1.6	
49	5	57	0	12	12	320	3P	M31	45.60	55.60	0	0	30	1.5	
49	5	58	0	12	12	320	3P	M31	45.61	55.65	0	0	30	1.5	
49	5	59	0	12	13	321	3P	M30	46.15	55.88	0	0	30	1.4	
49	5	60	0	12	13	321	3P	M30	46.10	55.75	0	0	30	1.5	
49	5	61	0	12	14	323	3P	L31	45.83	56.38	0	0	30	1.6	
49	5	62	0	12	14	323	3P	M31	45.65	55.07	0	0	30	1.5	
49	5	63	0	12	14	325	3P	N31	45.63	54.77	0	0	30	1.6	
49	5	64	0	12	14	326	3P	N31	45.60	54.42	0	0	30	1.6	
49	5	65	0	12	14	326	3P	N31	45.63	54.42	0	0	30	1.6	
49	5	66	0	12	14	325	3P	N31	45.75	54.70	0	0	30	1.5	
49	5	67	0	12	14	325	3P	N31	45.78	54.90	0	0	30	1.5	
49	5	68	0	12	14	325	3P	N31	45.92	54.77	0	0	30	1.5	
49	5	69	0	12	14	323	3P	M30	46.09	55.28	0	0	30	1.6	
49	5	70	0	12	14	324	3P	N30	46.23	54.87	0	0	30	1.6	
49	5	71	0	12	14	324	3P	N30	46.47	54.61	0	0	30	1.6	
49	5	72	0	12	15	322	3P	M30	46.27	55.35	0	0	30	1.5	
49	5	73	0	12	15	321	3P	M30	46.22	55.77	0	0	30	1.5	
49	5	74	0	12	15	321	3P	M30	46.09	55.50	0	0	30	1.5	
49	5	75	0	12	15	321	3P	M31	45.99	55.63	0	0	30	1.6	

	Witch Catch # of Fish	Witch Catch Weight (kg)	Set Duration (min)	Tow Distance (n.mi.)	Witch Mean Weight (kg)
Minimum	0.0	0.0	30.0	1.4	0.3
Maximum	351.00	167.00	30.00	1.60	1.50
Mean	8.77	4.09	30.00	1.51	0.62
Median	0.00	0.00	30.00	1.50	0.50
Standard Error	0.59	0.28	0.00	0.00	0.00
Total	640.00	298.40	2190.00	110.20	16.72
Count	73	73	73	73	73

Table 2a Stratified Analysis Estimated Witch Abundance and Biomass

WITCH GEAC 3PS 2000 No Zone

NUMBERS	STRATUM	NO.SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
	310	2	25.00	12.50	9255.	115693.	4.50
	311	2	2.00	1.00	17903.	17903.	2.00
	312	2	1.00	0.50	16281.	8141.	0.50
	313	2	22.00	11.00	11147.	122617.	18.00
	314	5	0.00	0.00	61748.	0.	0.00
	315	4	0.00	0.00	52357.	0.	0.00
	316	2	111.00	55.50	11147.	618660.	5940.50
	317	2	0.00	0.00	11620.	0.	0.00
	318	2	5.00	2.50	8715.	21787.	12.50
	319	5	332.14	66.43	66477.	4415963.	21555.96
	320	6	0.00	0.00	79988.	0.	0.00
	321	5	0.00	0.00	73503.	0.	0.00
	322	6	1.00	0.17	94648.	15775.	0.17
	323	3	0.00	0.00	47020.	0.	0.00
	324	2	0.00	0.00	33374.	0.	0.00
	325	4	0.00	0.00	63775.	0.	0.00
	326	2	0.00	0.00	11215.	0.	0.00
	705	2	23.57	11.79	13174.	155262.	36.73
	706	3	48.25	16.08	28509.	458526.	47.77
	707	2	21.29	10.64	4999.	53207.	80.83
	708	2	5.69	2.84	8512.	24207.	6.80
	712	3	12.00	4.00	49385.	197539.	7.00
	713	5	9.29	1.86	57492.	106770.	2.53

	TOTAL	UPPER	LOWER	MEAN	UPPER	LOWER
	6332050.	18575234.	-5911135.	7.61	22.32	-7.10

EFFECTIVE DEGREES OF FREEDOM= 4 STUDENTS T-VALUE= 2.78 ALPHA=0.05

WEIGHTS	STRATUM	NO.SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
	310	2	9.50	4.75	9255.	43963.	1.13
	311	2	0.50	0.25	17903.	4476.	0.13
	312	2	1.50	0.75	16281.	12211.	1.13
	313	2	10.50	5.25	11147.	58522.	6.13
	314	5	0.00	0.00	61748.	0.	0.00
	315	4	0.00	0.00	52357.	0.	0.00
	316	2	45.50	22.75	11147.	253595.	946.13
	317	2	0.00	0.00	11620.	0.	0.00
	318	2	4.00	2.00	8715.	17430.	8.00
	319	5	158.36	31.67	66477.	2105417.	4874.51
	320	6	0.00	0.00	79988.	0.	0.00
	321	5	0.00	0.00	73503.	0.	0.00
	322	6	0.50	0.08	94648.	7887.	0.04
	323	3	0.00	0.00	47020.	0.	0.00
	324	2	0.00	0.00	33374.	0.	0.00
	325	4	0.00	0.00	63775.	0.	0.00
	326	2	0.00	0.00	11215.	0	0.00
	705	2	8.57	4.29	13174.	56459.	2.30
	706	3	20.19	6.73	28509.	191944.	6.19
	707	2	15.82	7.91	4999.	39548.	19.09
	708	2	2.94	1.47	8512.	12529.	1.52
	712	3	5.50	1.83	49385.	90539.	1.33
	713	5	5.11	1.02	57492.	58724.	0.53

LOWER CONFIDENCE LIMITS ARE LESS THAN OR EQUAL TO ZERO

VARIANCE TOO LARGE FOR VALID CONFIDENCE INTERVAL AT THIS VALUE OF ALPHA-****

	TOTAL	UPPER	LOWER	MEAN	UPPER	LOWER
	2953143.	8757793.	-2851506.	3.55	10.52	-3.43

EFFECTIVE DEGREES OF FREEDOM= 4 STUDENTS T-VALUE= 2.78 ALPHA=0.05

Table 2b Stratified Analysis Estimated Witch Abundance and Biomass: Comparison for 1998-2000

3Ps Witch Estimates						
"numbers"abundance (millions of fish)						
	95% upper limit	Estimated	95% lower limit	95% upper limit	Mean #fish /tow	95% lower limit
1998	7.20	4.65	2.10	8.7	5.6	2.5
1999	46.48	23.70	0.92	55.9	28.5	1.1
2000 *	18.58	6.33	-	22.3	7.6	-
"weights" biomass (ktonnes)						
	95% upper limit	Estimated	95% lower limit	95% upper limit	Mean catch /tow (kg)	95% lower limit
1998	3.07	1.80	0.53	3.7	2.2	0.6
1999	19.11	9.60	0.95	23.0	11.5	0.1
2000 *	8.76	2.95	-	10.5	3.6	-
* Note: variance too large for valid lower limits for 2000						

Table 3a Stratified Analysis Witch Age Composition, Numbers per Standard Tow

WITCH GEAC 2000 3PS No Zone (S1 BY AGE)
ANALYSIS FOR TRIP 5 2000 VESSEL 49 ICNAF 3P

AGE COMPOSITION-NUMBERS PER STANDARD TOW
SUMMARY TABLE
SPECIES:SPECIES 0890
SEX:COMBINED

AGE IN YEARS	TOTAL NUMBERS	UPPER LIMIT	LOWER LIMIT	MEAN PER TOW	UPPER LIMIT	LOWER LIMIT	D.F.
0.0	0.	0.	0.	0.00	0.00	0.00	0
1.0	0.	0.	0.	0.00	0.00	0.00	0
2.0	0.	0.	0.	0.00	0.00	0.00	0
3.0	0.	0.	0.	0.00	0.00	0.00	0
4.0	0.	0.	0.	0.00	0.00	0.00	0
5.0	24918.	70956.	-21120.	0.03	0.09	-0.03	3
6.0	80202.	165642.	-5239.	0.10	0.20	-0.01	4
7.0	414583.	964268.	-135101.	0.50	1.16	-0.16	4
8.0	1097080.	2946304.	-752145.	1.32	3.54	-0.90	4
9.0	2297334.	7004586.	-2409917.	2.76	8.42	-2.90	4
10.0	1622106.	5111590.	-1867377.	1.95	6.14	-2.24	4
11.0	481593.	1516117.	-552932.	0.58	1.82	-0.66	4
12.0	222517.	687070.	-242036.	0.27	0.83	-0.29	4
13.0	66788.	208489.	-74912.	0.08	0.25	-0.09	4
14.0	12464.	47069.	-22140.	0.01	0.06	-0.03	4
UNKNOWN	0.	0.	0.	0.00	0.00	0.00	0
TOTAL	6319585.	18571354.	-5932185.	7.59	22.31	-7.13	4

ESTIMATION TYPE:STANDARD TRANSFORMATION TYPE:NONE CONFIDENCE LEVEL: 0.95%
****-ONE OR MORE OF THE LOWER LIMITS IN THE ABOVE TABLE IS LESS THAN OR EQUAL TO ZERO. VARIANCE IS TOO LARGE FOR VALID CONFIDENCE LIMITS ****

Table 3b Stratified Analysis Estimated Witch Abundance Year Class Distribution: Comparison for 1998-2000

	3Ps Witch Estimates					
	"number" abundance (millions of fish)			Mean #fish/tow		
Year Class	1998	1999	2000	1998	1999	2000
1995	0.00	0.00	0.02	0.00	0.00	0.03
1994	0.01	0.06	0.08	0.02	0.07	0.10
1993	0.09	0.50	0.41	0.11	0.60	0.50
1992	0.09	2.21	1.10	0.10	2.65	1.32
1991	0.47	6.00	2.30	0.57	7.21	2.76
1990	1.05	6.79	1.62	1.27	8.16	1.95
1989	1.61	5.13	0.48	1.93	6.16	0.58
1988	0.83	1.97	0.22	1.00	2.36	0.27
1987	0.39	0.74	0.07	0.46	0.88	0.08
1986	0.09	0.13	0.01	0.11	0.16	0.01

Table 4a Witch abundance estimates (thousands of fish)
from GEAC surveys in NAFO Division 3Ps from 1998-2000

Depth range (fathoms)	Strata	Vessel Trip #Sets Mean Date sq. mi.	Pennysmart 3 86 6-Dec 1998	Pennysmart 4 90 27-Nov 1999	Pennysmart 5 73 10-Dec 2000
<30	314	974	0	0	0
	320	1320	100	0	0
		Subtotal	100	0	0
31-50	312	272	41	15	8
	315	827	10	35	0
	321	1189	0	0	0
	325	944	0	0	0
	326	166	0	0	0
		Subtotal	51	50	8
51-100	311	317	0	752	18
	317	193	0	120	0
	319	984	1548	19271	4416
	322	1567	0	11	16
	323	696	0	20	0
	324	494	0	0	0
		Subtotal	1548	20174	4450
101-150	310	170	69	116	116
	313	165	290	69	123
	316	189	591	1828	619
	318	129	290	35	22
		Subtotal	1240	2048	880
151-200	705	195	244	184	155
	706	476	551	580	459
	707	74	35	77	53
		Subtotal	830	841	667
201-300	708	126	38	38	24
	712	731	230	123	198
	713	851	613	431	107
		Subtotal	881	592	329
	Total [1]		4,650	23,705	6,334

[1] Totals are for all strata fished. Individual strata totals rounded to nearest 1000.

Table 4b Witch biomass estimates (t)
from GEAC surveys in NAFO Division 3Ps from 1998-2000

Depth range (fathoms)	Strata	Vessel Trip #Sets Mean Date sq. mi.	Pennysmart 3 86 6-Dec 1998	Pennysmart 4 90 27-Nov 1999	Pennysmart 5 73 10-Dec 2000
<30	314	974	0	0	0
	320	1320	28	0	0
		Subtotal	28	0	0
31-50	312	272	15	8	12
	315	827	4	9	0
	321	1189	0	0	0
	325	944	0	0	0
	326	166	0	0	0
		Subtotal	19	17	12
51-100	311	317	0	215	4
	317	193	0	38	0
	319	984	745	7938	2105
	322	1567	0	5	8
	323	696	0	14	0
	324	494	0	0	0
		Subtotal	745	8210	2117
101-150	310	170	14	32	44
	313	165	101	39	59
	316	189	245	821	254
	318	129	98	22	17
		Subtotal	458	914	374
151-200	705	195	67	59	56
	706	476	198	178	192
	707	74	33	36	40
		Subtotal	298	273	288
201-300	708	126	11	17	13
	712	731	56	45	91
	713	851	188	124	59
		Subtotal	255	186	163
	Total [1]		1,803	9,600	2,954

[1] Totals are for all strata fished. Individual strata totals rounded to nearest 1000.

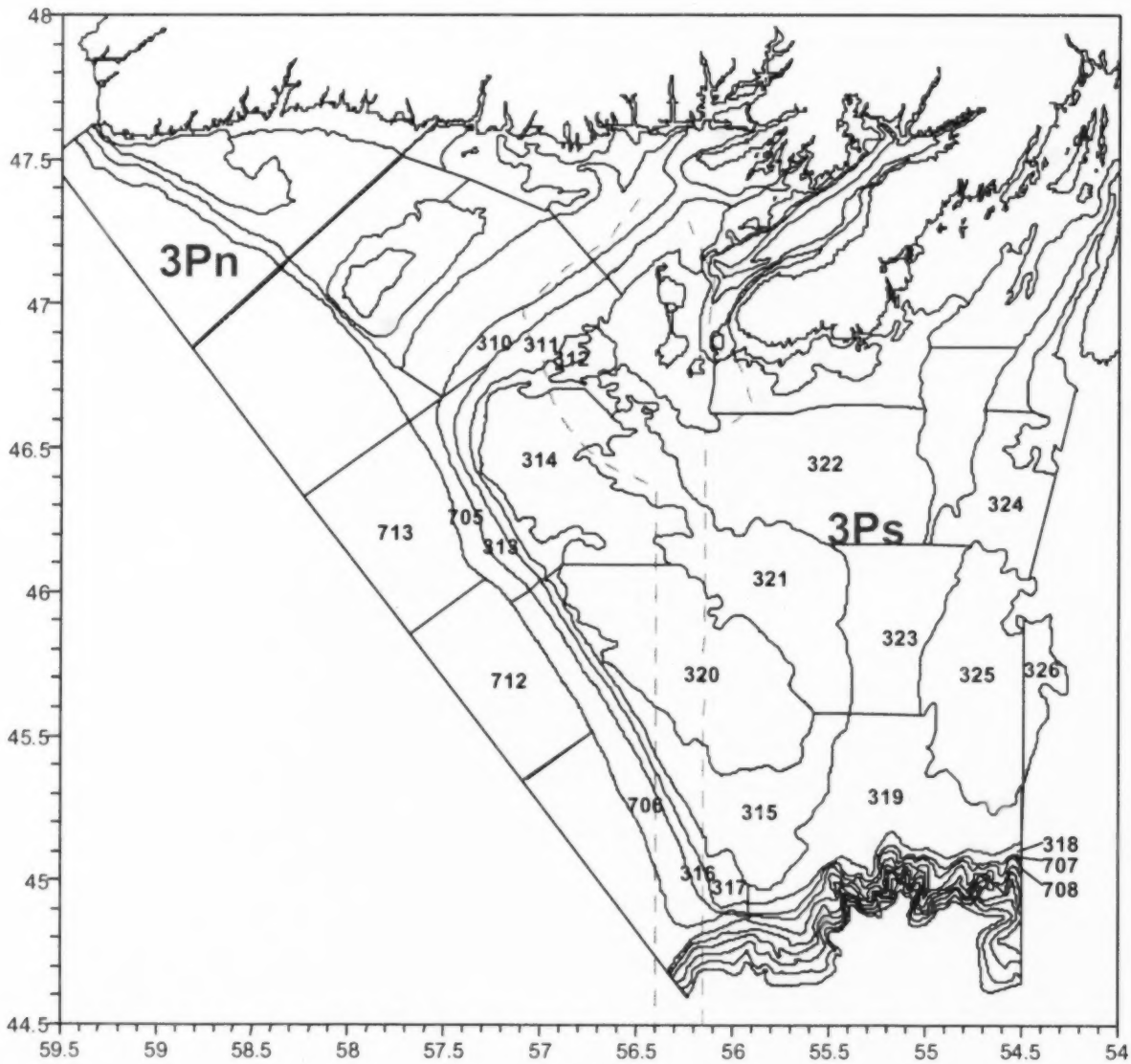

Figure 1 Stratum boundaries within NAFO Division 3P.
Numbered strata indicate those surveyed during fall GEAC bottom trawl survey of Subdivision 3Ps.
Dashed line is boundary of French economic zone which was not surveyed.

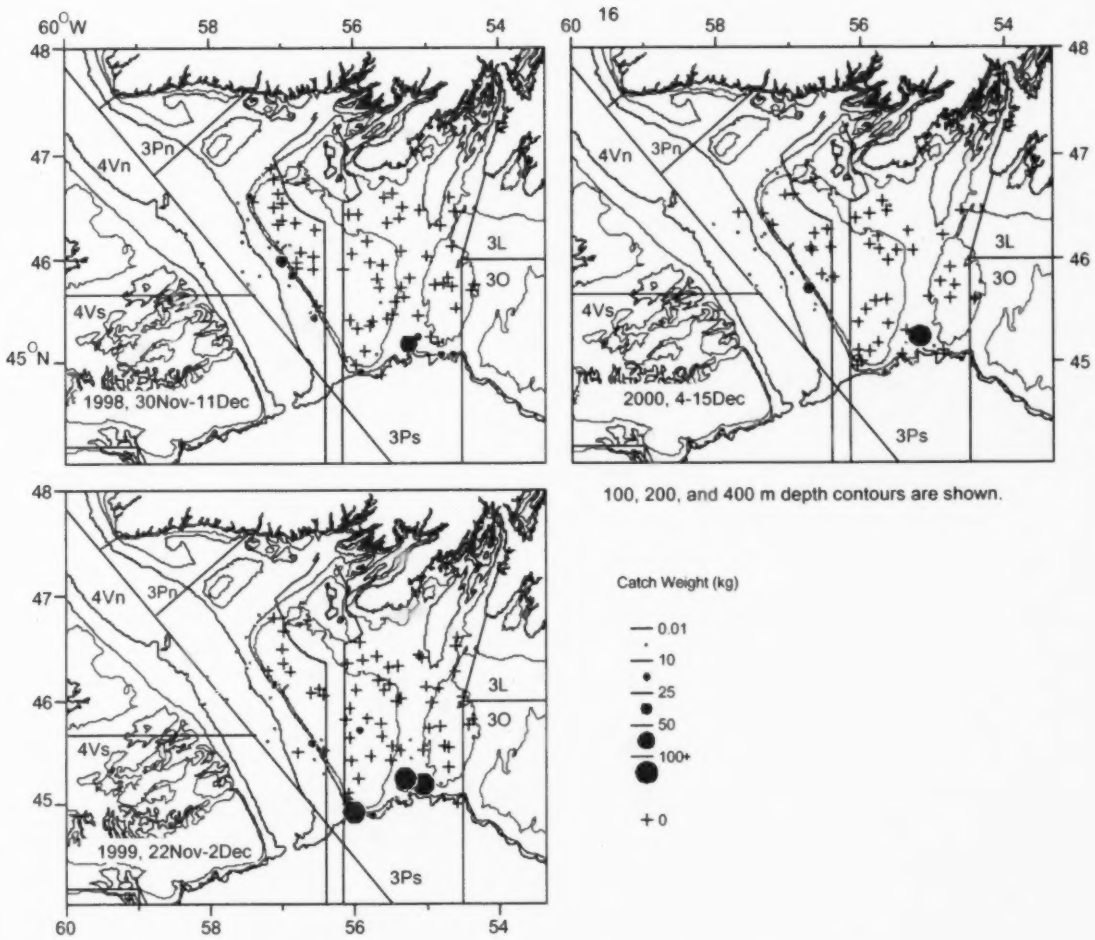

Figure 2 Witch Catch Weight Distribution from GEAC Stratified Random Surveys, 3Ps, 1998-2000.

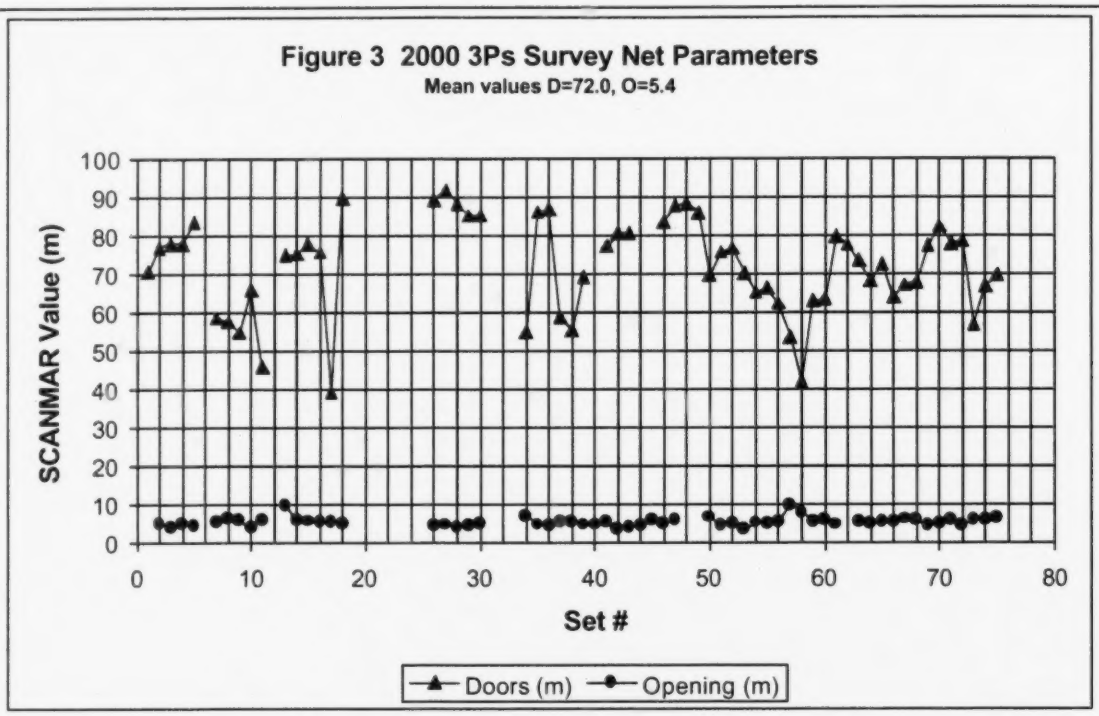
Figure 3 2000 3Ps Survey Net Parameters
Mean values D=72.0, O=5.4
SCANMAR Value (m)
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
Set #
Doors (m)
Opening (m)

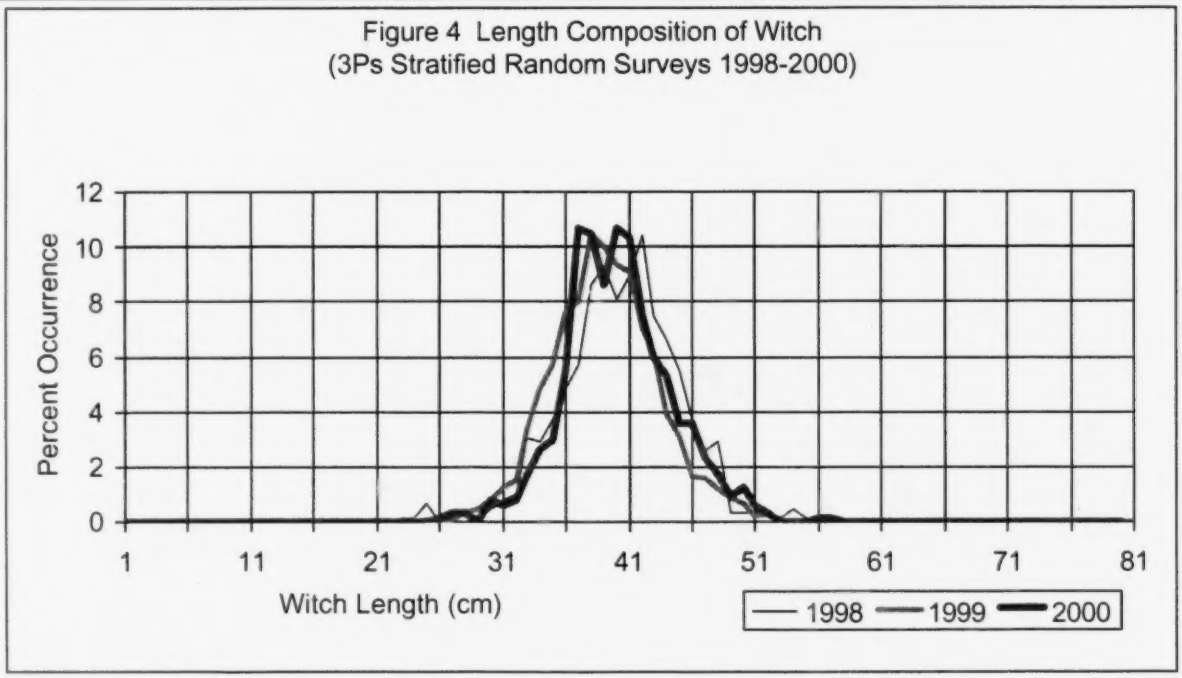
Figure 4 Length Composition of Witch
(3Ps Stratified Random Surveys 1998-2000)
Percent Occurrence
12
10
8
6
4
2
0
1
11
21
31
41
51
61
71
81
Witch Length (cm)
1998
1999
2000

Figure 5a Witch Age-Length Composition
3Ps 2000 (209 samples)

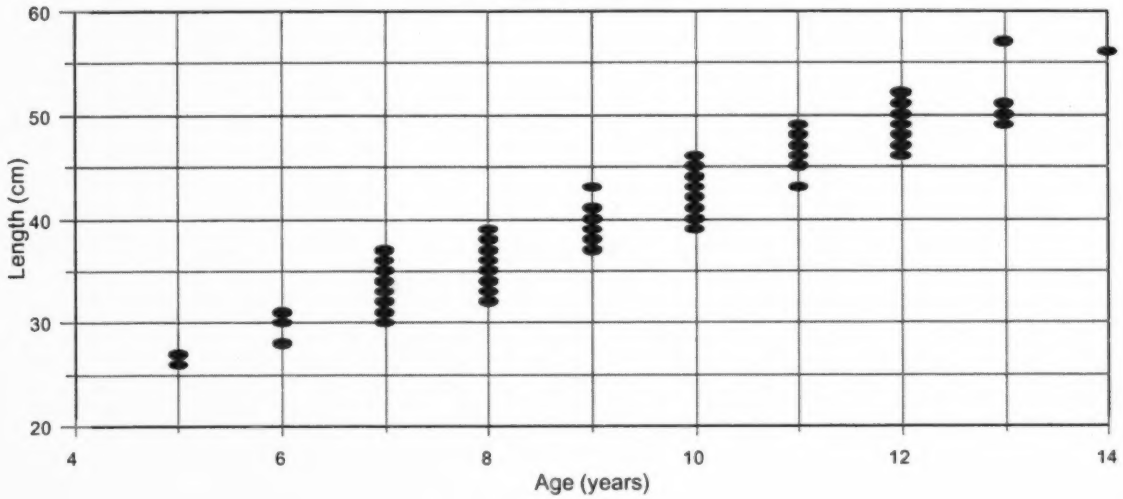

Figure 5b Age Composition of Witch
3Ps Sampled Witch

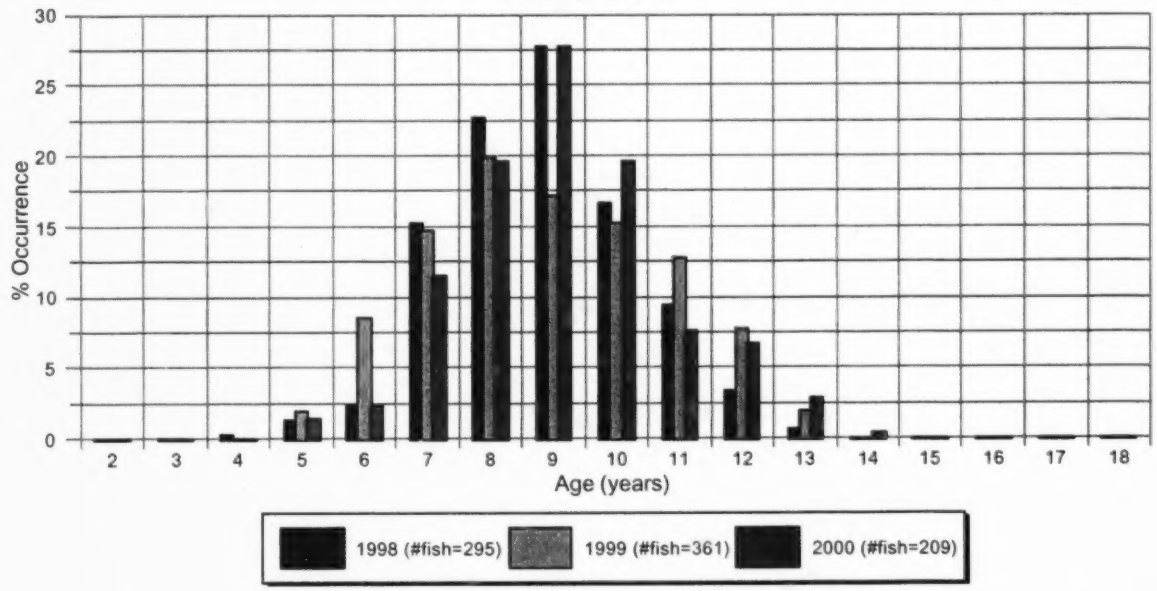

Figure 6a Age Composition of Witch
Estimated Mean #s per tow (3Ps)

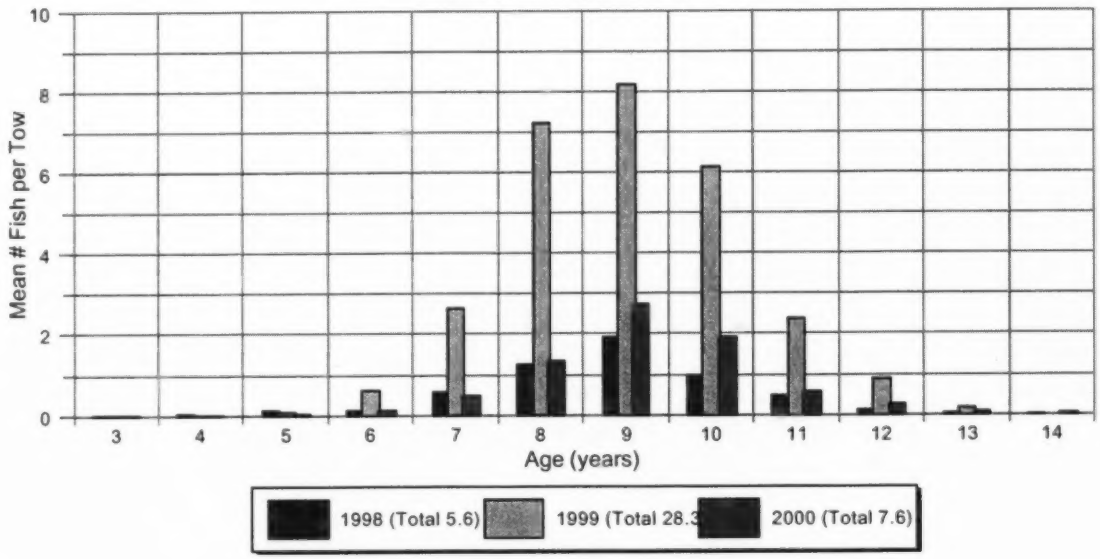

Figure 6b Age Composition of Witch
Estimated % Total Mean #s per tow(3Ps)

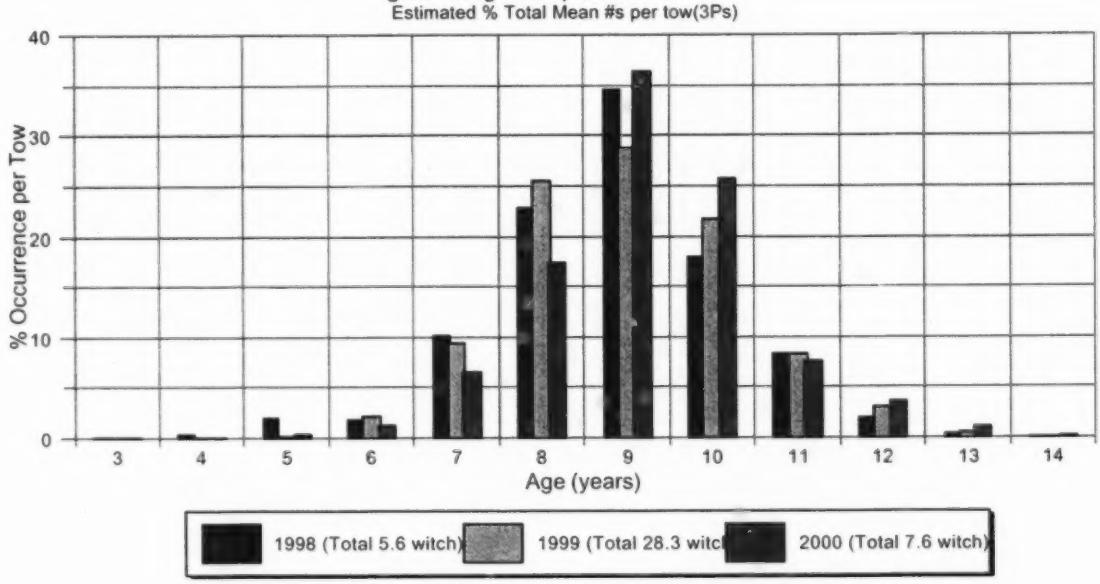

Figure 7a Year Class Composition
3Ps Witch Estimated Mean #s per tow

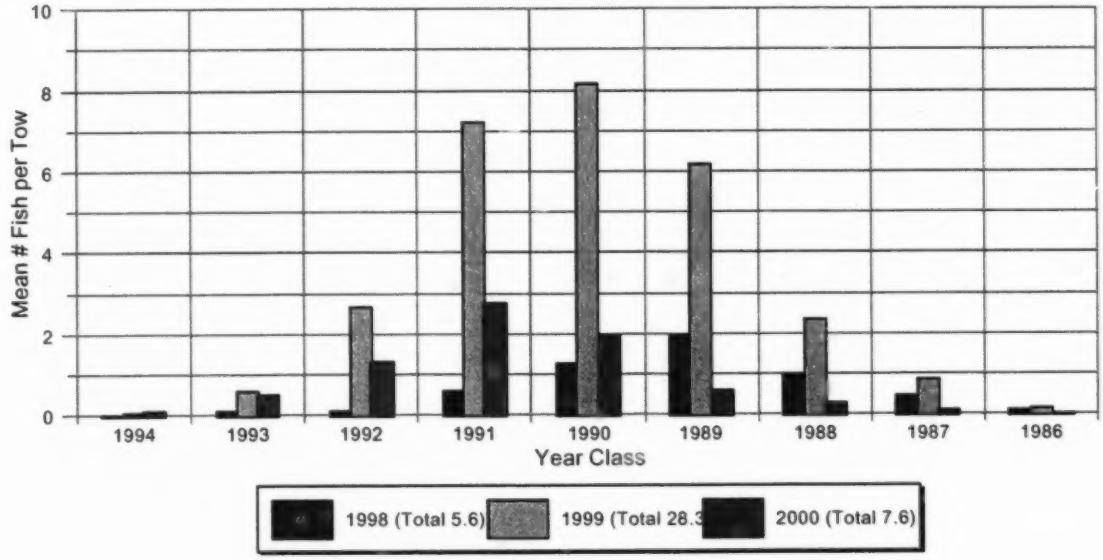

Figure 7b Year Class Composition
3Ps Witch Est. % Total Mean #s/tow

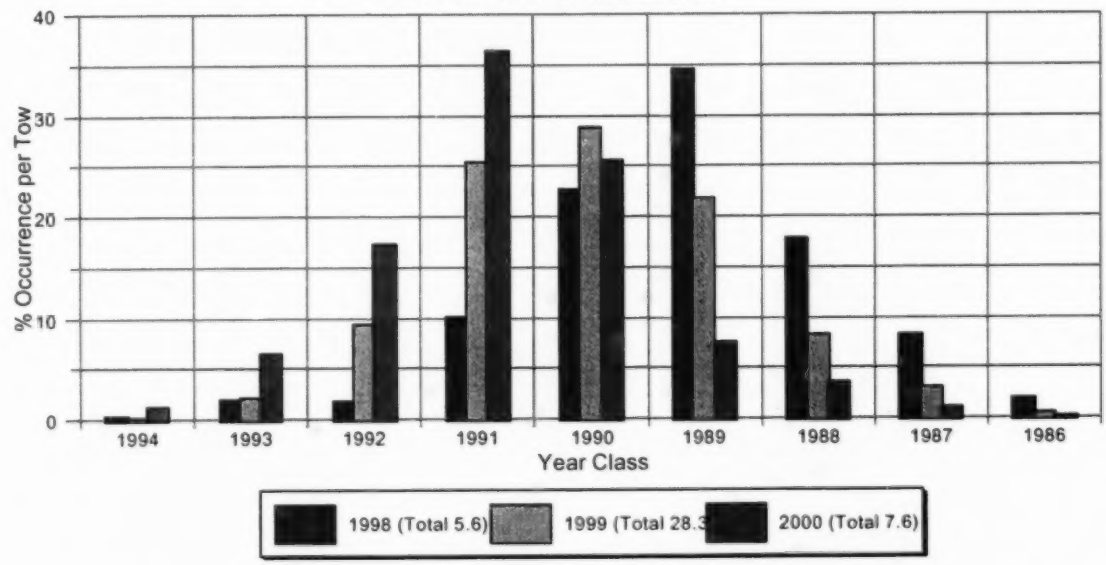

Figure 8 Witch Survey Abundance index at length, 3Ps, 1998-2000